EFFECT OF SOME ETHYLENE INHIBITORS AND SOME GROWTH REGULATORS ON VASE LIFE AND KEEPING QUALITY OF CUT *EUCALYPTUS* LEAVES

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Abstract

This study were carried out at post harvest Lab of the Department of Ornamental plants Res. and Landscape Gardening, Hort. Res. Inst. Agric. Res. Center, Giza during two seasons (2006 and 2007). The aim of this study was to investigate the effect of using some ethylene inhibitors, some growth regulators and storage periods on the longevity of cut leaves and branches of *Eucalyptus pulverulenta* "Baby Blue" in order to improve their quality and extend their vase life. Branches were pulsed in a distilled water, Florissant - 400 (4 ml/l), Florissant - 400 (4 ml/l) + sucrose(5%) and Florissant - 400 (4ml/l) + sucrose (5%) + GA_3 (150 ppm) for 48 hours. The branches were stored for 0,2 and 3 weeks at 5°C then were placed in jars of 300 ml holding solution containing sucrose (2%), 8-hydroxyquinoline citrate (200 ppm) under lab conditions until the end of experiment. The obtained data indicated that pulsing of cut branches in Florissant-400 (4 ml/l) + sucrose (5%) + GA_3 (150 ppm) was the most effective treatment for increasing quality, extending vase life, reducing leaf yellowing and increasing fresh weight percentage. Results concerning storage period revealed that the weight loss percentage increased with prolonging storage duration. The results of interaction showed that pulsing branches with a solution containing Florissant -400 (4 ml/l) + sucrose (5%) + GA_3 (150 ppm) for 48 hours then storage for 0 (without storage) or 2 weeks gave the highest vase life and quality and reduced depletion of total sugars content and pigments in the leaves.

INTRODUCTION

Cut foliage, including Eucalyptus "Baby Blue" (*Eucalyptus pulverulenta*) belongs to family Myrtacea is a product group that can be very interesting for local and export from Egypt. Eucalyptus is extensively used by the floral industry for the beautiful cut foliage for flower arrangements. The leaves are small, blue-green in color and scented. The bouquet market is the fastest growing market segment and there is a huge demand for foliage especially for adding to bouquets. Also, cut foliage is used to decorate the rooms in our homes. Others are used to beautify the areas around our homes and public buildings. Short vase life could be one of the most important reasons for the inability of florists to develop any appreciable to use market in Egypt. However, with flowers and foliage that are in good condition, ideal care given them by the retailer and customer can easily double their vase life.

Foliar chlorosis is considered the primary factor contributing to the loss of postproduction longevity of potted Easter lilies (Staby and Erwin, 1977). Seventy percent of "Nellie White" leaves turned yellow within 3 days after being stored at 2ºC for 3 weeks (Prince *et al.*, 1987).

The effects of growth regulators and Florissant – 400 (a floral preservatives) on leaf senescence vary greatly among plant species. Gibberellin (GA) is reported to delay leaf senescence of a few species, but the physiological effects of GA on leaf senescence are not clear. Studies on nasturtium (*Tropaeolum majus* L.) suggested a relationship between GA_3 content in leaves and the onset of senescence (Beevers, 1966). Florissant- 400 (4 ml/l) treatment for *Eucalyptus parvifolia* reduced ethylene production and increased vase life (Ferrante *et al.*, 1998).

Sucrose treatment extended the vase life and inhibited ethylene production in oriental liliy "Stargazer" (Han, 2003). Also, sucrose is the major form of photosyntheically assimilated carbon that is transported in plants (Lalonde *et al.*, 1999).

The aim of this study was to investigate the effect of Florissant- 400, Florissant -400 + sucrose, Florissant -400 + GA_3+ sucrose and storage period on keeping quality and extending vase life period of cut Eucalyptus branches harvested at the mature stage.

MATERIALS AND METHODS

This research was carried out at Horticultural Research Institute, Giza for two successive seasons (2006 and 2007).

Materials:

The following chemical treatments with the different levels were used:

A- Pulsing solution:

1- Control, distilled water (D. W.) for 48 hours.

2- Florissant -400 (4ml/l) which contains QUAT-Bactericide (non- chlorine based) for 48 hours.

3- Florissant- 400 (4 ml/l) + sucrose (5%) for 48 hours.

4- Florissant -400 (4ml/l)+ sucrose (5%) + GA_3 (150 ppm) for 48 hours.

B - Holding solution (preservative solutions) which contains sucrose (2%) + 8-hydroxyquinoline citrate (200 ppm).

Plant material and procedures:

Eucalyptus branches (*Eucalyptus pulverulenta*) were harvested at mature stage from certain mother trees in a commercial farm. The branches were precooled by placing in ice cold water for 2 hours to remove the effect of high field heat. Stem bases were recut in air by removing about 3 cm from it. Branches were divided into four groups and were placed for 48 hours in the following pulsing solutions:

Distilled water (control), Florissant -400 (4ml/l), Florissant -400 (4ml/l) + sucrose (5%) and Florissant -400 (4ml/l) + sucrose (5%) + GA_3 (150 ppm). The branches were then divided into three sub groups: branches were placed in jars of 300 ml holding solution sucrose (2%) + 8-hydroxyquinoline citrate (200 ppm) under lab conditions (0 week). The other two sub groups were wrapped in tightly sealed polyethylene film (30 micron thickness) then packed in carton boxes (102 x 50 x 30 cm) to be stored at 5ºC for 2 and 3 weeks. At the end of the storage duration, all sub groups were placed in the holding solution as mentioned above to complete their vase life.

Measurements:

1- Evaluation of weight loss % at the end of storage period.
2- The longevity of branches was defined as the number of days in vase life required for 50% of the leaves to become chlorotic or necrotic.
3- Water uptake(cm^3) was determined by weighing the coverd jars with and without the branches every two days.
4- The percentage of fresh weight during vase life period.
5- The percentage of chlorotic or necrotic leaves.
6- Chlorophyll and careteniods (mg/100g) were determined in leaves colorimetrically according to Saric *et al.* (1967).
7- Total sugars content in the leaves (percentage) was determined colorimetrically according to the method described by Dubois *et al.* (1956)

Layout of the experiment was complete randomized design in factorial experiment containing 12 treatments (4 pulsing solutions x 3 storage periods). Each treatment was repeated three times. The jar contained 300 ml of preservative solution and three branches, i.e. 9 branches per treatment. The branches were performed in an ambient environment lab at 22ºC ± 2, 50-60% RH and 24 h lighting by fluorescent lamp of 1000 lux. The obtained data were statistically analyzed according to Snedecor and Cochran (1982) and means were compared by New Less Significant Difference (L.S.D) test at the 5% level of probability in the two seasons.

RESULTS AND DISCUSSION

The effects of postharvest treatments, cold storage period and their interaction on *Eucalyptus pulverulenta* "Baby Blue" branches were examined.

1-The longevity of cut foliage (day): The results in Table (1) show that all pulsing solutions significantly increased the longevity of cut branches over control. The highest longevity of branches was found in pulsing solution of Florissant -400 (4ml/l) + sucrose (5%) + GA_3 (150 ppm) (14.80 and 15.18 days) as compared to other treatments during the first and second seasons, respectively. The differences were significant. This is in agreement with Ferrante *et al.*, (1998) on *Ecualyptus parvifolia* who found that Florissant -400 (4 ml/l) treatment reduced ethylene production and increased vase life. Hicklenton (1991) on *Alstroemeria hybrida* pointed out that pulsing treatment of GA_3 effectively reduced foliage yellowing over 14 days and maintained color intensity.

Table 1. Effect of postharvest treatment and cold storage duration at 5°c on longevity (day) of *Eucalyptus pulverulenta* "Baby Blue" branches in the two seasons (2006 & 2007).

	First season					Second season				
St. per.	Treatments									
	1	2	3	4	Means	1	2	3	4	Means
0 week	12.7	16.5	17.0	19.0	16.29	12.0	16.0	17.6	19.3	16.23
2 weeks	9.0	11.0	12.0	15.0	11.75	9.7	12.0	12.9	15.3	12.44
3 weeks	5.0	8.3	9.5	10.4	8.29	6.5	8.0	9.0	11.0	8.63
Means	8.89	11.92	12.83	14.80		9.40	12.00	13.15	15.18	

L.S.D. Values at 5% level:-

Factors	T.	St. Per.	Int.	T.	St. Per.	Int.
L.S.D Values	1.35	1.17	2.34	1.15	1.01	2.02

1= Control (distilled water)	2 = Florissant -400
3 = Florissant -400 + Sucrose	4 = Florissant -400 + Sucrose + GA3
T. = Treatments	St. Per. = Storage period
Int. = Interactions	

Storing branches for 0 week significantly enhanced longevity of cut branches compared with the other treatments followed by storing for 2 weeks during the two seasons. The results of interaction (postharvest treatment x cold storage duration) cleared that all pulsing solutions with storage for 0 or 2 weeks significantly surpassed the storage for 3 weeks. However, the most effective treatment in this regard was pulsing in Florissant -400 + sucrose + GA_3 x 0 week storage during the two seasons. These results were in agreement with these of Menguc *et al.*, (1994) on carnation who mentioned that STS treatment increased vase life but cold storage decreased it.

Table 2. Effect of postharvest treatment and cold storage duration at 5ºc on water uptake (cm^3) of *Eucalyptus pulverulenta* "Baby Blue" branches in the two seasons (2006 & 2007).

St. per.	First season					Second season				
	Treatments									
	1	2	3	4	Means	1	2	3	4	Means
0 week	74.0	98.8	103.8	118.2	98.7	70.3	94.2	100.5	115.0	95.0
2 weeks	50.0	75.0	78.7	98.6	75.6	52.2	73.8	75.9	95.0	74.2
3 weeks	25.0	41.5	45.7	63.8	44.0	23.5	40.7	45.8	60.0	42.5
Means	49.7	71.8	76.1	93.5		48.7	69.6	74.0	90.0	

L.S.D. Values at 5% level:-

Factors	T.	St. Per.	Int.	T.	St. Per.	Int.
L.S.D Values	3.38	2.93	5.86	2.90	2.51	5.02

1= Control (distilled water)	2 = Florissant -400
3 = Florissant -400 + Sucrose	4 = Florissant -400 + Sucrose + GA3
T. = Treatments	St. Per. = Storage period
Int. = Interactions	

2- Water uptake (cm^3): data concerning the effect of pulsing solutions and storage duration and their interaction on water uptake are presented in Table (2) which show differences in water uptake (cm^3) of *Eucalyptus pulverulenta* when subjected to different pulsing solutions and storage durations. Using pulsing solutions significantly enhanced the water uptake over control and the highest effective pulsing solution in this regard was Florissant -400 + sucrose + GA_3 (93.5 and 90.0 cm^3) in the first and second seasons, respectively). At 0 week the rate of water uptake was significantly higher than that for branches stored for two weeks in both seasons. The branches stored in cold temperature for two weeks had a significantly higher magnitude in absorbing water than those stored for three weeks in both seasons.

The data of interaction (postharvest treatments x cold storage duration) shown in Table (4) indicate that Florissant -400 + sucrose + GA_3 led to the highest increase in water uptake from vases along storage period with its maximum at 0 week (118.2 and 115.0 cm^3) in the first and second seasons, respectively) compared to the other treatments in a significant way in both seasons.

These results coincided with the findings of Rekha *et al.* (2002) who found that sucrose + GA_3 delayed senescence of gladiolus by increasing water uptake. Ferrante *et al.* (2002) on *Eucalyptus parvifolia* pointed out that water uptake was declined at the end of vase life of cut foliage stored for 4 weeks.

3- The percentage of fresh weight: Table (3) indicate that all pulsing solutions significantly increased the percentage of fresh weight for branches placed in vases than those in control in both seasons. However, Florissant -400 + sucrose + GA_3 gained more weight (5.94 and 6.04% in the first and second seasons, respectively) than the other treatments. The differences were significant in both seasons. Concerning the effect of cold storage period, it can be observed from Table (3) that 0 week treatment recorded an increase in the fresh weight over cold storage periods of 2 and 3 weeks. The differences were significant in both seasons. Storage period of 2 weeks enhanced the fresh weight of branches placed in vases after storage more than 3 weeks in both seasons. This work on Eucalyptus branches indicated higher reduction in the fresh weight of branches during storage which might be due to water loss as storage period increased so, 2 weeks storage was preferred than 3 weeks in this respect. The results of the interaction (postharvest treatments x storage duration) show that the most effective treatment in this regard was the treatment of pulsing in Florissant -400 + sucrose + GA_3 x storing at 0 week and 2 weeks cold storage which gained more fresh weight during both seasons. This agreed with the results found by Ferrante *et al.*, (2002) on *Eucalyptus parvifolia* who found that the longest practical storage was 3 weeks without losing the ornamental value.

Table 3. Effect of postharvest treatment and cold storage duration at 5ºc on the percentage of fresh weight increase during vase life of *Eucalyptus pulverulenta* "Baby Blue" branches in the two seasons (2006 & 2007).

	First season					Second season				
St. per.	Treatments									
	1	2	3	4	Means	1	2	3	4	Means
0 week	4.2	5.9	6.0	7.0	5.76	4.0	5.6	5.9	7.2	5.67
2 weeks	3.1	4.0	4.8	5.9	4.48	3.0	4.3	5.0	6.0	4.57
3 weeks	2.3	3.5	4.0	4.9	3.65	2.1	3.6	4.4	5.0	3.75
Means	3.18	4.45	4.94	5.94		3.02	4.50	5.09	6.04	

L.S.D. Values at 5% level:

Factors	T.	St. Per.	Int.	T.	St. Per.	Int.
L.S.D Values	0.87	0.75	1.51	0.97	0.84	1.74

1= Control (distilled water)	2 = Florissant -400
3 = Florissant -400 + Sucrose	4 = Florissant -400 + Sucrose + GA3
T. = Treatments	St. Per. = Storage period
Int. = Interactions	

Table 4. Effect of postharvest treatment and cold storage duration at 5°c on chlortic or necrotic leaves percentage of *Eucalyptus pulverulenta* "Blue Baby" branches during the two seasons (2006 & 2007).

St. per.	First season					Second season				
	Treatments									
	1	2	3	4	Means	1	2	3	4	Means
0 week	12.4	8.3	6.0	4.0	7.69	14.0	8.0	6.3	4.0	8.08
2 weeks	24.0	17.1	12.3	7.0	15.10	24.6	16.5	11.0	6.1	14.54
3 weeks	55.0	30.2	21.0	13.2	29.86	52.3	33.0	19.0	11.0	28.83
Means	30.48	18.54	13.10	8.08		30.30	19.17	12.10	7.02	

L.S.D. Values at 5% level:-

Factors	T.	St. Per.	Int.	T.	St. Per.	Int.
L.S.D Values	2.01	1.74	3.48	1.84	1.55	3.10

1= Control (distilled water)	2 = Florissant -400
3 = Florissant -400 + Sucrose	4 = Florissant -400 + Sucrose + GA3
T. = Treatments	St. Per. = Storage period
Int. = Interactions	

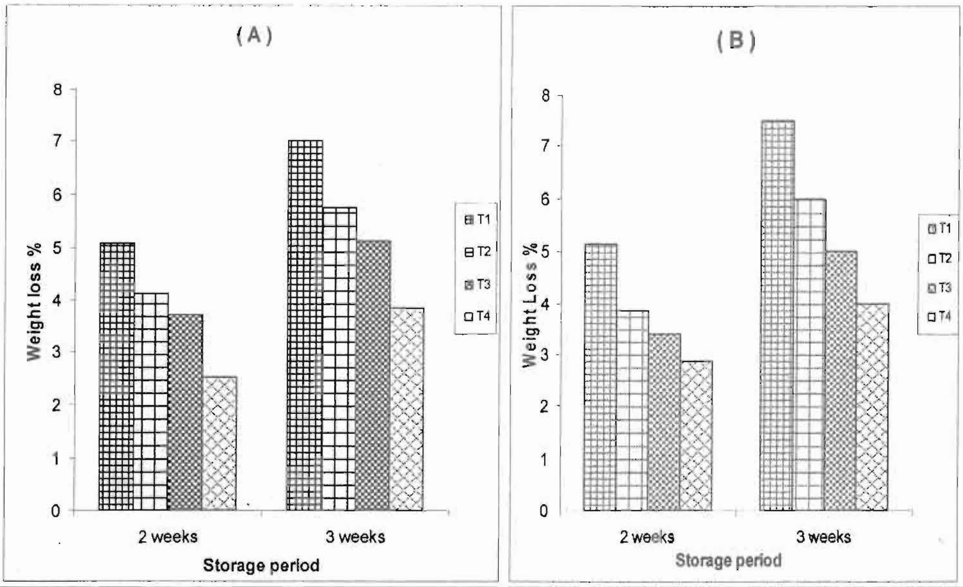
4- Chlorotic or necrotic leaves percentage: Data in Table (4) show the effect of postharvest treatment and cold storage duration and their interaction on chlorotic leaves percentage. All pulsing solutions significantly reduced the percentage of chlorotic leaves compared to control in both seasons. Pulsing branches of Eucalyptus in Florissant -400 + sucrose + GA_3 was the most effective treatment on preventing postharvest leaf yellowing compared to the other treatments. The differences were significant in both seasons. Concerning the effect of cold storage period, it can be observed from Table (4) that cold storage induce leaf yellowing more than those non cold stored. The 3 weeks of cold storage significantly affected the leaves more chlorotic than the other cold storage period in both seasons. The results of the interaction between pulsing branches in Florissant -400 + sucrose + GA_3 and storage for 0 and 2 weeks before holding the branches in a vase solution was the most effective treatment on reducing the chlorotic leaves percentage compared to the other treatments in both seasons. These results are in agreement with those of Han (2001) on *Lillium* sp who found that pulsing in solutions containing 25 mg/l each of BA and GA_4+$_7$ for 4 hours prevented leaf yellowing. Also, the longer duration of cold storage, the earlier development of leaf yellowing and the higher percentage of leave which those were chlorotic. In this respect Ranwala and Miller (2002) on Hybrid lilies stated that gibberelin treatments prevented leaf chlorosis of cold stored stems in a similar fashion that was observed in non-stored stems.

5- The percentage of Branches weight loss during dry cold storage at 5°C: The data in Fig (1) indicate that the percentage of Eucalyptus branches weight loss was gradually increased when dry cold storage period exceeded than two weeks to reach its maximum loss at three weeks cold storage at 5ºC in the two seasons. The branches pretreated with Florissant -400 + sucrose + GA_3 showed the lowest percentage of loss in fresh weight of branches compared to the other treatments in both seasons. The results of interactions (postharvest treatments x storage period) show that the highest percentage loss of weight was obtained with control along storage period with its maximum at three weeks in both seasons. The least weight loss was achieved with Florissant 400 + sucrose + GA_3 for two weeks cold storage duration in both seasons. These results are in agreement with those of El-Saka (1996) on Iris flowers who found that weight loss of flowers increased with extending storage period up to 21 days.

6- Total sugars percentage in the leaves: Data in Fig (2) illustrate that all pulsing solutions increased total sugar percentage in leaves over control in both seasons. Florissant-400 + sucrose + GA_3 gave the highest value compared to the other treatments in both seasons. As the cold storage period for 0 week followed by two weeks were better than three weeks cold storage period concerning total sugars percentage in the leaves in both seasons. The interaction effects show that Florissant -400 + sucrose + GA_3 then storage for 0 week or two weeks were the best treatments for obtaining the highest percentage of total sugars in the leaves compared with the other treatments in both seasons. The mentioned results coincided with the findings of Jones (1995) on Leucadendron stems who stated that total soluble sugars content in leaf tissue was declined during storage.

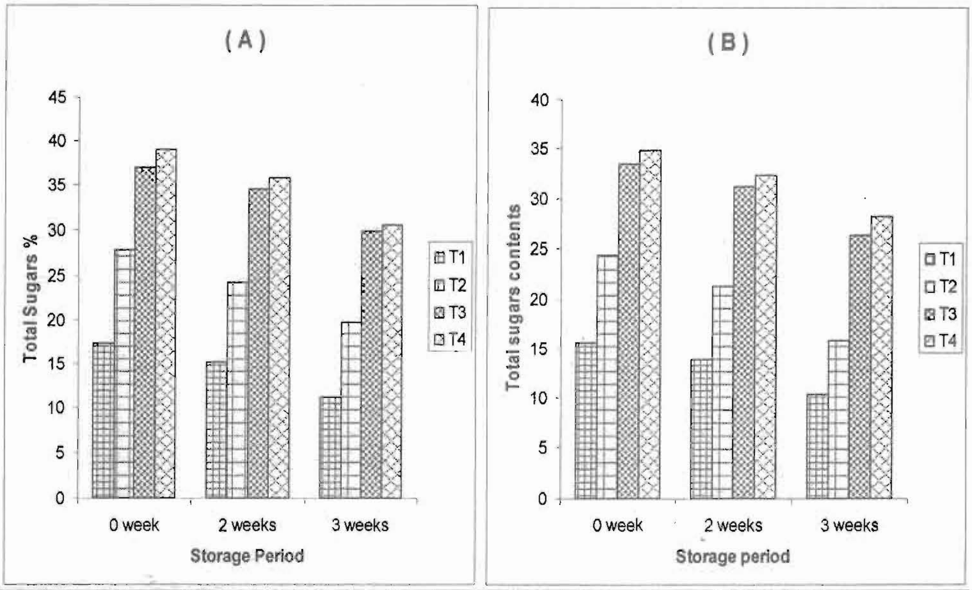
7-Chlorophyll and caroteniods content in leaves: Data in Fig (3,4 and 5) demonstrate that the different pulsing solutions increased the level of chlorophyll a and b over control in both seasons. Florissant -400 + sucrose + GA_3 gave the highest level of chlorophyll a and b compared to the other treatments in the two seasons. On the other hand, control increased only the level of caroteniods over the other treatments in both seasons.

The effect of storage periods: Data in Fig (3,4 and 5) record a continuous decrease in chlorophyll a and b and increase in caroteniods content with the extension of storage period in both seasons. The interaction between postharvest treatments and storage period reveal that chlorophyll a and b were decreased while caroteniods increased with the prolonging of storage period up to 3 weeks in all pulsing solutions in both seasons. Treatment of Florissant -400 + sucrose + GA_3 and storage for 0 week followed by 2 weeks storage increased chlorophyll contents over the other treatments in both seasons. These results are in harmony with those of Young *et al.*,(1996) on Asiatic hybrid lily who found that the use of preservative solution containing HQC + sucrose + GA_3 after pretreatment with STS + sucrose + GA_3 + $MnCl_2$ kept the foliage green until the end of vase life. Ferrante *et al.*, (2002) on *Eucalyptus parvifolia* mentioned that chlorophyll content showed differences after storage but reached the same values in all treatments towards the end of vase life.



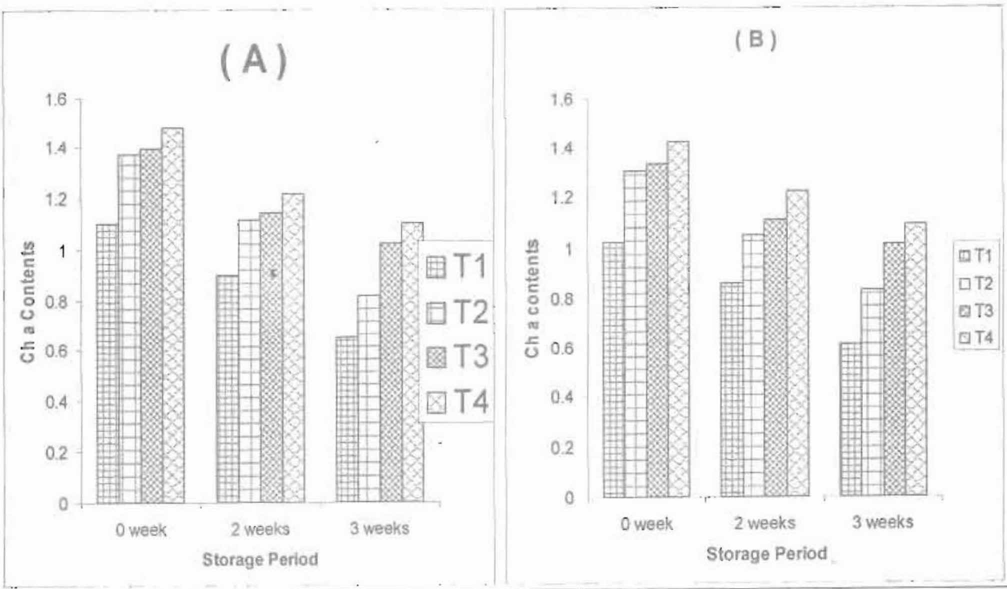
T1 = Control (distilled water)	T2 = Florissant -400
T3 = Florissant -400 + Sucrose	T4 = Florissant -400 + Sucrose + GA3

Figure (1) -Effect of postharvest treatment and cold storage duration at 5ºC on percentage of flower Weight loss of Eucalyptus pulverulenta "Baby Blue" branches during the first season (A) and the second season (B) (2006 and 2007)



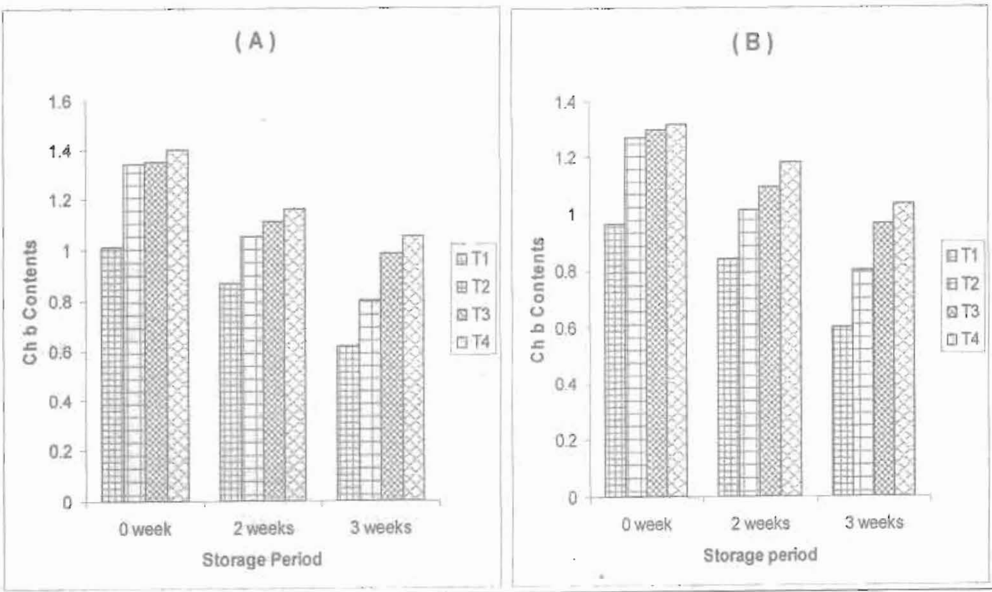
T1 = Control (distilled water)	T2 = Florissant -400
T3 = Florissant -400 + Sucrose	T4 = Florissant -400 + Sucrose + GA3

Figure (2) -: Effect of postharvest treatment and cold storage duration at 5ºC on total Sugar percentage of Eucalyptus pulverulenta "Baby Blue" branches during the first season (A) and the second season (B) (2006 and 2007).



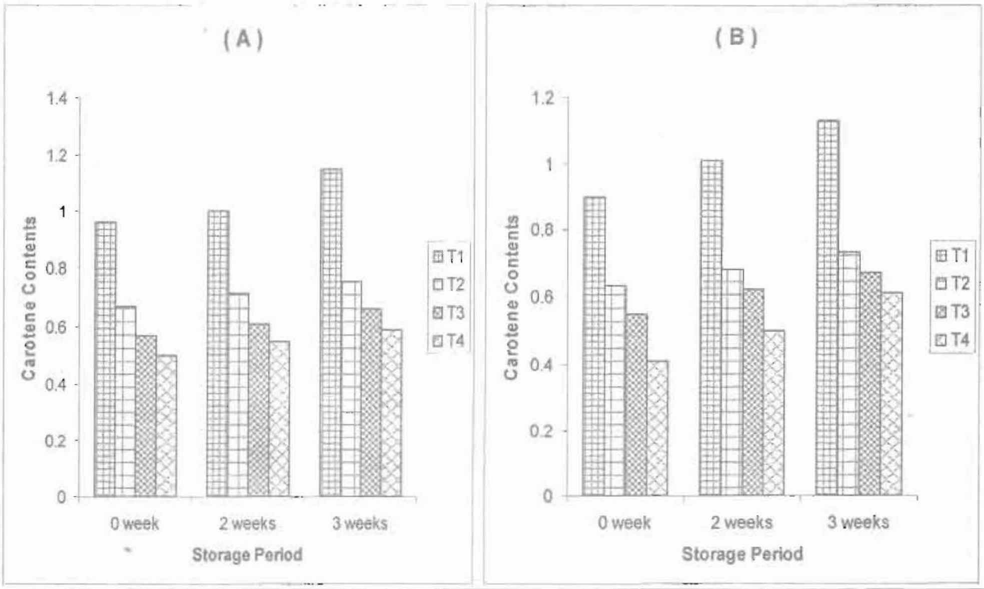
T1 = Control (distilled water)	T2 = Florissant -400
T3 = Florissant -400 + Sucrose	T4 = Florissant -400 + Sucrose + GA3

Figure (3) -: Effect of postharvest treatment and cold storage duration at 5ºC on Chlorophyll a contents of *Eucalyptus pulverulenta* "Baby Blue" branches during the two seasons (2006 and 2007).



T1 = Control (distilled water)	T2 = Florissant -400
T3 = Florissant -400 + Sucrose	T4 = Florissant -400 + Sucrose + GA3

Figure (4) -: Effect of postharvest treatment and cold storage duration at 5ºC on Chlorophyll b contents of Eucalyptus pulverulenta "Baby Blue" branches during the two seasons (2006 and 2007).



T1 = Control (distilled water)	T2 = Florissant -400
T3 = Florissant -400 + Sucrose	T4 = Florissant -400 + Sucrose + GA3

Figure (5) -: Effect of postharvest treatment and cold storage duration at 5ºc on Carotinoids content of Eucalyptus pulverulenta "Baby Blue" branches during the two seasons (2006 and 2007).

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تأثير بعض المواد المثبطة للايثلين وبعض منشطات النمو على إطالة عمر والحفاظ على جودة أوراق الكافور المقطوفة

أمال عبد الغفار زكى

قسم بحوث نباتات الزينة وتنسيق الحدائق- معهد بحوث البساتين – مركز البحوث الزراعية- جيزة.

أجرى هذا البحث فى معمل بحوث تداول الزينة بمعهد بحوث البساتين خلال موسمى ٢٠٠٦-٢٠٠٧ وذلك بهدف دراسة تأثير بعض المواد المثبطة للايثلين وبعض منشطات النمو على اطالة عمر وتحسين جودة أوراق الكافور المقطوفة "بيبى بلو". حيث غمست قواعد الأفرع لمدة ٤٨ ساعة فى كل من الماء المقطر، (Florissant -400) بتركيز ٤ مللى/لتر ، (Florissant- 400بتركيز ٤ مللى/لتر + سكروز (٥%) ، (Florissant -400) بتركيز ٤ مللى/لتر+ سكروز (٥%) + حمض الجبرالين بتركيز ١٥٠ جزء فى المليون. قسمت الأفرع الى أفرع بدون تخزين حيث تم وضعها فى محلول الفازة وأفرع تم تخزينها تخزين جاف على درجة ٥م° لمدة ٢، ٣ أسابيع وبعد انتهاء فترة التخزين وضعت الأفرع فى محلول الفازة الذى يتكون من ٢% سكروز ، ٢٠٠ جزء فى المليون ٨-هيدروكسى كينولين سترات. وأهم النتائج التى تم الحصول عليها كانت كالتالى:

- معاملة الغمس فى (Florissant -400) بتركيز ٤ مللى/لتر + سكروز (٥%) + حمض الجبريليك ١٥٠ جزء فى المليون هى الأكثر تأثيرا على زيادة جودة الأفرع واطالة فترة حياتها وتقليل اصفرار الأوراق وزيادة النسبة المئوية للوزن الطازج للأفرع.
- أدى التخزين البارد للأفرع الى أنه كلما زادت فترات التخزين كلما زادت النسبة المئوية للفقد فى الوزن.
- الأفرع التى تم معاملتها بـ (Florissant -400) ٤ مللى/لتر +سكروز ٥% + حمض الجبريليك ١٥٠ جزء فى المليون (بدون تخزين) والأفرع المخزنة لمدة أسبوعين على درجة ٥م° أعطت أعلى زيادة فى عمر الأوراق وجودتها وقللت استنزاف السكريات والصبغات فى الأوراق.